Design and Simulation of Evaluation Model of Teaching Reform Achievements in Colleges and Universities

Wang Rui

Dept. of Information System, Dalian Naval Academy, Dalian 116018, China

yuezhiying@yeah.net

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Abstract: In order to improve the quantitative evaluation of the achievements of teaching reform in colleges and universities, and realize the descriptive statistical analysis and accurate evaluation of the results of teaching reform in colleges and universities, an evaluation model of teaching reform achievement in colleges and universities is proposed based on piecewise linear fitting and data mining, the characteristic attribute values reflecting the results of teaching reform in colleges and universities are constructed, including scientific research achievements, teaching results, college students' innovative ability and teachers' strength. Combined with descriptive statistical analysis method, the quantitative evaluation of teaching reform is carried out, and the statistical analysis model of teaching reform achievement evaluation in colleges and universities is constructed, and the attribute data of teaching reform results are processed by fuzzy C-means clustering. The feature quantity of association rules is extracted, and the segmented linear fitting is carried out according to the feature extraction results. The benefit correlation data of teaching reform results are mined, and the evaluation of teaching reform results in colleges and universities is realized according to the results of data mining. The simulation results show that, the model is used to evaluate the achievements of teaching reform in colleges and universities with good accuracy, which has good convergence of regression analysis, and remarkable reliability of evaluation results.

1. Introduction

With the deepening of the teaching reform in colleges and universities, the strength of the teaching reform has been strengthened constantly, and the educational cause and the teaching reform of colleges and universities in China have made good achievements. Higher education is an important combination of the first productive force of science and technology and the first resource of talents, it has played an important role in the whole teaching system [1]. The outline of the educational plan clearly states that "improving quality is the core task of the development of higher education," it is the basic requirement of building a powerful country in higher education. In order to further guide colleges and universities to adapt themselves to the sound and rapid economic and social development, to promote the all-round development of human beings, to promote social harmony and progress, and to deepen the reform of education and teaching in colleges and universities. It has become an important task for current higher education to raise the level of undergraduate talents. On the whole, higher education in our country has not been fully adapted to the requirements of economic and social development and good education for the people. Compared with the international advanced level, there is still a gap [2]. In order to further improve the level of higher teaching, aiming at the problems such as the unreasonable professional structure of colleges and universities, the lack of distinctive characteristics of running a school, the weak construction and training of teachers, and so on [3], we should strengthen the cultivation of college students' practical and innovative ability. Through the reform and construction for a period of time, we strive to achieve obvious results and better meet the needs of economic and social development for applied talents, compound talents and top-notch innovative talents, in order to better evaluate the achievements of teaching reform in colleges and universities. It is necessary to establish the

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evaluation model of teaching reform achievements in colleges and universities, and combine the statistical analysis and mathematical modeling method to carry out quantitative evaluation and analysis of the achievements of teaching reform in colleges and universities [4].

The research on the evaluation model of the teaching reform achievement in colleges and universities is taken based on the statistical analysis of the relevant information of the teaching reform in colleges and universities. The data processing and information fusion processing of the original information are carried out. In traditional methods, the evaluation method of college teaching reform results is mainly taken based on Web-based MSNs (WMSNs)[5], which is constructed based on Web mobile social network. The trust evaluation model is used to establish the evaluation model which accords with the value characteristics of the teaching reform achievements in colleges and universities [6], but the traditional quantitative evaluation model has a high computational cost and high complexity. In the traditional method, the analytic hierarchy process (AHP) is used to evaluate the achievement of teaching reform in colleges and universities, and the nonlinear time series analysis method is used to model the spatial distribution of information characteristics in the comprehensive evaluation of the achievements of teaching reform in colleges and universities. It constructs the control objective function of the comprehensive evaluation of the teaching reform achievements in colleges and universities by using the analytic hierarchy process, and deals with the comprehensive evaluation index parameters of the teaching reform achievements in colleges and universities by cluster fusion. However, the accuracy and convergence of the statistical analysis of the evaluation of teaching results are not high.

In view of the above problems, an evaluation model of teaching reform achievement is proposed based on piecewise linear fitting and data mining. Combined with descriptive statistical analysis method, the quantitative evaluation of teaching reform results is carried out, the experiment is taken, result analysis shows the superiority of this method in improving the accuracy of comprehensive evaluation of teaching reform achievements in colleges and universities.

2. Analysis model of constraint parameter index and construction of objective function for comprehensive evaluation of teaching reform achievements

2.1 Constraint index analysis of comprehensive evaluation of teaching reform achievements

In order to realize the comprehensive evaluation of teaching reform achievements in colleges and universities, information mining and data classification methods are used to analyze the constraint parameters for comprehensive evaluation of the achievements of teaching reform in colleges and universities. The optimal distribution model of association rules is established for the comprehensive evaluation information of teaching reform achievements in colleges and universities. Based on the autocorrelation matching method, the feature extraction of association attributes and adaptive classification of comprehensive evaluation information of teaching reform results in colleges and universities are carried out. The index of constraint parameters of comprehensive evaluation information of teaching reform in colleges and universities is analyzed by using the grouping method of retrieval nodal graph model, and the descriptive statistical analysis method is combined [7]. Under the background of big data, the optimal relevance classification of the comprehensive evaluation information of college teaching reform achievement is carried out. Assuming that the number of constraint parameter information sources for comprehensive evaluation of teaching reform results in colleges and universities is unknown, in the design of control model for comprehensive evaluation of teaching reform achievements in colleges and universities, the coordinate region of semantic feature distribution should be restricted. The information graph model structure of comprehensive evaluation of teaching reform achievement in colleges and universities is represented by binary directed graph $G=(V,A)$. The distribution characteristics of comprehensive evaluation information of teaching reform achievements in colleges and universities are described as follows:

$$H'(X)=-\sum_i \mu_i \sum_j p_{i,j}(A)\log(p_{i,j}(A)) \tag{1}$$

Assuming the edge set of the classifying node in the decision tree of the comprehensive evaluation information of the teaching reform results in colleges and universities is A, using the descriptive statistical analysis method, the relational dimension distribution function of the comprehensive evaluation information of the teaching reform results in colleges and universities is expressed as follows:

$$Ncut(A,B)=\frac{cut(A,B)}{assoc(A,V)}+\frac{cut(A,B)}{assoc(B,V)} \tag{2}$$

Wherein, $assoc(A,V)$ refers to the autoregressive feature vector of the optimal relevance subset A of the comprehensive evaluation information of the teaching reform achievement in colleges and universities. The nearest neighbor sampling of the comprehensive evaluation information of the teaching reform achievement in colleges and universities is carried out in the decision tree model of directed graph to construct the high level. The index system of constraint parameters for the comprehensive evaluation of the achievements of teaching reform in colleges and universities, and the construction of characteristic attribute values reflecting the achievements of teaching reform in colleges and universities, including the achievements of scientific research, the cost parameters of the evaluation model are as follows: the teaching results, the innovative ability of college students and the teachers' strength, etc., which are expressed as:

$$\boldsymbol{X}=\begin{bmatrix}\boldsymbol{x}_1\\ \boldsymbol{x}_2\\ \vdots\\ \boldsymbol{x}_3\end{bmatrix}=\begin{bmatrix}\boldsymbol{a}_1^T\boldsymbol{c}_1 & \boldsymbol{a}_1^T\boldsymbol{c}_2 & \cdots & \boldsymbol{a}_1^T\boldsymbol{c}_m\\ \boldsymbol{a}_2^T\boldsymbol{c}_1 & \boldsymbol{a}_2^T\boldsymbol{c}_2 & \cdots & \boldsymbol{a}_2^T\boldsymbol{c}_m\\ \vdots & \vdots & \ddots & \vdots\\ \boldsymbol{a}_N^T\boldsymbol{c}_1 & \boldsymbol{a}_N^T\boldsymbol{c}_2 & \cdots & \boldsymbol{a}_N^T\boldsymbol{c}_m\end{bmatrix} \tag{3}$$

The above formula is a phase space reconstruction matrix $\boldsymbol{X}$ with dimension $N\times m$, which represents the descriptive statistical parameters of the comprehensive evaluation of the achievements of teaching reform in colleges and universities.

2.2 Objective function of the comprehensive evaluation of the teaching reform achievement

The nonlinear time series analysis method is used to model the spatial distribution of information features in the comprehensive evaluation of the achievements of teaching reform in colleges and universities. The principle of optimizing the clustering of the characteristic information of the achievements of teaching reform in colleges and universities is based on the extraction of data information [8]. This paper constructs the time series model of the characteristic information flow of the teaching reform in colleges and universities, and combines the characteristic information flow of the teaching reform in colleges and universities with the characteristic information flow of the teaching reform in colleges and universities. In the reconstruction of mapping phase space, the characteristic distribution matrix associated with the achievements of teaching reform in colleges and universities is described as follows:

$$\boldsymbol{L}=\begin{bmatrix}\boldsymbol{x}_1^T\\ \boldsymbol{x}_2^T\\ \vdots\\ \boldsymbol{x}_N^T\end{bmatrix}=\begin{bmatrix}x_1 & x_{1+\tau} & \cdots & x_{1+(m-1)\tau}\\ x_2 & x_{2+\tau} & \cdots & x_{2+(m-1)\tau}\\ \vdots & \vdots & \ddots & \vdots\\ x_{N-1} & x_{N-1+\tau} & \cdots & x_{N-1+(m-1)\tau}\end{bmatrix} \tag{4}$$

The correlation function $C(\tau)$ of the evaluation of teaching reform achievement in colleges and universities is defined as:

$$C(\tau)=\lim_{T\to\infty}\frac{1}{T}\int_{-\frac{T}{2}}^{\frac{T}{2}}x(t)x(t+\tau)d\tau \tag{5}$$

Scalar time series analysis method is used to fuse information, the principal component characteristics of the results of teaching reform is:

$$C_{or3}=\frac{\left\langle\left(x_n-\bar{x}\right)\left(x_{n-d}-\bar{x}\right)\left(x_{n-D}-\bar{x}\right)\right\rangle}{\left\langle\left(x_n-\bar{x}\right)^3\right\rangle} \tag{6}$$

Based on this characteristic parameter, the information fusion is carried out to realize the self-adaptive mining and evaluation of the achievements of teaching reform in colleges and universities.

3. Evaluation model optimization of teaching reform achievement

3.1 Fuzzy C mean clustering

In order to realize the descriptive statistical analysis and accurate assessment of the achievements of teaching reform in Colleges and universities, this paper achievements of teaching reform in Colleges and universities evaluation model and a piecewise linear approximation based on data mining. The test statistic evaluation results of college teaching reform analysis model, attribute data on the results of teaching reform of the fuzzy C mean clustering, association rule extraction characteristics [9]. According to the feature extraction results are piecewise linear fitting, the evaluation results of teaching reform of statistics limited data set X is divided into C class, attribute class teaching reform in Colleges and universities get results feature information set information gain:

$$Info(B)=-\sum_{i=1}^{m}p_i\times\log_2 p_i \tag{7}$$

$$Info_A(B)=\sum_{j=1}^{v}\frac{|B_j|}{|B|}\times Info(B_j) \tag{8}$$

$$Gain(A)=Info(B)-Info_A(B) \tag{9}$$

Wherein, A,B are data feature categories, there are n samples in the data set of the evaluation of teaching reform achievement in colleges and universities to be excavated. The correlation characteristics of sample x_i, $i=1,2,\cdots,n$ are expressed as follows:

$$x_n=a_0+\sum_{i=1}^{M_{AR}}a_i x_{n-i}+\sum_{j=0}^{M_{MA}}b_j\eta_{n-j} \tag{10}$$

Wherein, a_0 represents the test statistics, a_i is the embedded phase space dimension of the comprehensive evaluation and distribution attributes of the teaching reform achievements in colleges and universities, η_{n-j} is the benefit gain coefficient of teaching reform achievement evaluation.

3.2 Statistical analysis on evaluation of teaching reform achievements

The comprehensive evaluation index parameters of the teaching reform achievements in colleges and universities are treated by cluster fusion, and the decision function of the evaluation of the reform results is described as follows:

$$L_\xi=\begin{cases}|f(x)-y|-\xi & |f(x)-y|\geq\xi\\ 0 & |f(x)-y|<\xi\end{cases} \tag{11}$$

Wherein, ζ_l and ζ_l^* are the relaxation variables, ξ is the insensitive loss function, c is complexity of the AHP model for the comprehensive evaluation of the achievements of teaching reform in colleges and universities. According to the mining results of association rules, the iterative formula for evaluating the achievements of teaching reform in colleges and universities is obtained:

$$x_{n+1} = 4x_n(1-x_n) \qquad n = 1,2,\cdots,NP \tag{12}$$

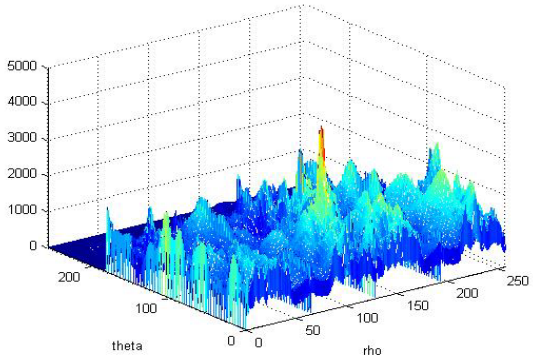
Some sample data are normalized, the fitness function is adjusted, and the association rule data clustering is realized in the classifier. Among them, the process of normalizing the characteristic information of the teaching reform results is as follows:

$$x_i^{'} = \frac{x_i}{\|x_i\|} = (\frac{x_{i1}}{\|x_i\|}, \frac{x_{i2}}{\|x_i\|}, \cdots, \frac{x_{iN}}{\|x_i\|}) \tag{13}$$

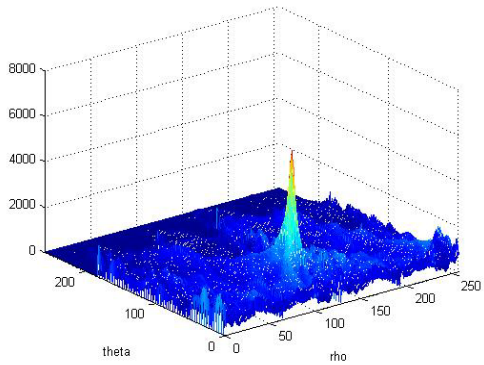
According to the data mining results, the evaluation of the teaching reform results in colleges and universities is realized, and the fuzzy evaluation decision of the teaching reform results in colleges and universities is realized by using the empirical test and analysis method.

3.3 Simulation experiment analysis

In order to test the performance of this algorithm in quantitative evaluation of the achievement of teaching reform in colleges and universities, a simulation experiment is carried out. The statistical value of the initial sample is as follow $N_s = 200,500,700,1000$, the distributed attenuation factor of the characteristic information clustering center of teaching reform λ=0.25, the fitness of statistical test analysis T=5, the number of iterations for fuzzy decision evaluation is 100, and the sample data set for empirical analysis is DDR3 sample data set. According to the above simulation environment and parameter setting, the evaluation model of university teaching achievement is simulated and analyzed. The clustering comparison of the evaluation results is obtained by using the method of this paper and the traditional method, which is shown in Figure 1.



(a) Traditional method



(a) This method

Fig. 1 Clustering comparison of evaluation of teaching reform achievements

Figure 1 shows that the clustering property of the evaluation of teaching reform results by using this model is good, which shows that the accuracy of evaluation is higher. The accuracy of testing different methods for evaluating teaching results is shown in Figure 2.

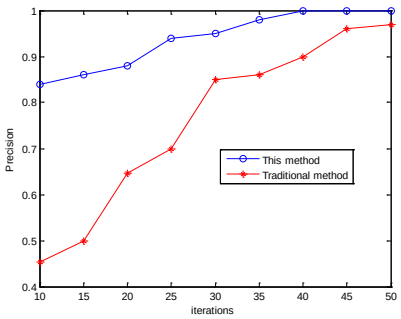


Fig. 2 Comparison of accuracy of teaching achievement evaluation

In Figure 2, it shows that this method is more accurate and convergent.

4. Conclusions

In this paper, an evaluation model of teaching reform achievement in colleges and universities is proposed based on piecewise linear fitting and data mining, the characteristic attribute values reflecting the results of teaching reform in colleges and universities is constructed. Combined with descriptive statistical analysis method, the quantitative evaluation of teaching reform results is carried out, and the statistical analysis model of teaching reform achievement evaluation in colleges and universities is constructed. The feature quantity of association rules is extracted, and the segmented linear fitting is carried out according to the feature extraction results. The benefit correlation data of teaching reform results are mined, and the evaluation of teaching reform results in colleges and universities is realized according to the results of data mining. The simulation results show that, the model is used to evaluate the achievements of teaching reform in colleges and universities with good accuracy, it has good convergence of regression analysis, and it has remarkable reliability of evaluation results, which shows good application value in practice.

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